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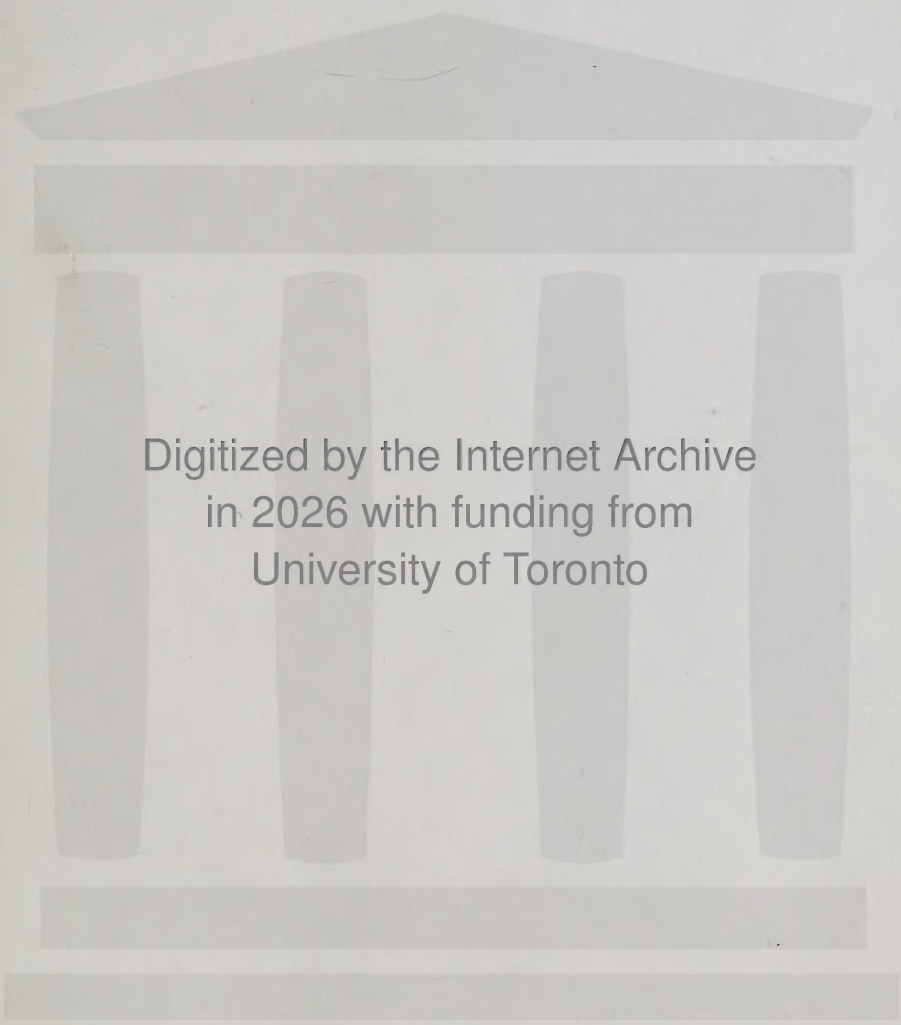

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THE HISTORY AND PRESENT STATE OF SCIENTIFIC RESEARCH IN THE :- DUTCH EAST INDIES. -:

GEOGRAPHY.

DEVELOPMENT OF THE GEOGRAPHICAL KNOWLEDGE OF THE MALAY ARCHIPELAGO

BY

L. VAN VUUREN.

1923.

PRINTED BY J. H. DE BUSSY, AMSTERDAM.

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GEOGRAPHY.

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FIRST PERIOD.

From the earliest times to the coming of the Europeans, 1511 A.D.

At the western edge of the primeval Pacific ocean there lies between the two massive continents of Asia and Australia an extensive archipelago, which separates this ancient ocean from the Indian. Along the Pacific the Archipelago is bordered by the series of islands stretching from New Guinea by way of Halmahera and the Philippines to Formosa, while on the other side it is separated from the Indian ocean by the Sunda arc which extends from the Australian continent, via Java and Sumatra, to the Malay Peninsula. Between this peninsula and Sumatra lies the famous old route of the MALLACA STRAIT, the passage for everyone and everything from the ancient centre of civilisation in India to the no less ancient centre of civilisation in China.

Herein lies the oldest significance of the archipelago: a *transitional territory* between the two centres of civilisation, India and China. The Straits of Malacca are its centre of gravity.

Accordingly it is in the ancient writings of the Hindus and in the accounts of the voyages of Chinese mariners and religious travellers that we find the first data concerning the Malay Archipelago. In his study on "Java en het Goudeiland volgens de oudste berichten" (Java and the Gold island, according to the earliest accounts) published in "Bijdragen tot de Taal-, Land- en Volkenkunde van Ned.-Indië", third series, vol. IV, 1869, pp. 638–648, Prof. H. KERN has made accessible to us the most ancient account from the well known poem, Ramayana.

Numerous other writings of this scholar have revealed the results of further investigation of this first period, which has left us also many inscriptions on stone tablets, on the solid rock and on copper tables, which often throw much light on the conditions which existed in the archipelago as it gradually became a *settled region*. KERN's "Verspreide geschriften" (Miscellaneous writings) The Hague, MARTINUS NIJHOFF 1913–19 contains many facsimiles of these inscriptions.

The Hindus seem also to have been the informants of PTOLEMY the Alexandrian geographer who about 150 A.D. first collected what was known to the West about the Far East. In his "Researches on PTOLEMY's Geography of Eastern Asia (Further India and Indo-Malay Archipelago)" London 1909, G. E. GERINI has attempted the identification of the various

THE EASTERN INDIAN OCEAN, ACCORDING TO PTOLEMY.

PLATE I.

localities mentioned by PTOLEMY, basing it on the writings of the Hindus and Chinese. PTOLEMY's conception of the Far East, with the Malay peninsula, his "Aurea Chersonesus", as centre, is best shown by the maps on plates I and II. G. P. ROUFFAER, in his article on "Tochten" (voyages) in the Encyclopaedie van Nederlandsch Indië, 1905 edition, has mentioned all PTOLEMY's data and identified them as far as possible.

For centuries PTOLEMY's book and his summary of knowledge remained the only source of information for the west. After having gradually fallen into oblivion, it was rediscovered in the fifteenth century and was then printed in numerous works together with knowledge acquired subsequently. [1])

The accounts of Chinese travellers, of whom FA HIAN, I TSING and HIUEN TSANG are the best kwown, were made accessible by W. P. GROENEVELDT in his "Notes on the Malay archipelago and Malacca. Compiled from Chinese sources. Batavia, March 6th 1876. In: Verh. Gen. v. K. en W. Vol. XXXIX. 1880. (Compare foot note by G. P. ROUFFAER on p. 120 of his "Was Malaka emporium.... enz." In: Bijdragen, vol. 77 part. I. 1920).

In this there occurs further a list of the Chinese works consulted by GROENEVELDT, including "The twenty four Historians", a work of about 900 large volumes. [2])

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[1]) The following may be consulted: G. COEDÈS. Textes d'auteurs grecs et latins relatifs à l'Extrême Orient depuis le IVe siècle avant J. C. Paris 1910. In: Documents histor. et géogr. relat. à l'Indo-Chine — . . . Tome. I.

HUGO BERGER. Geschichte der wissenschaftlichen Erdkunde der Griechen. Zweite verbesserte und ergänzte Auflage. Leipzig 1903.

VIVIEN DE SAINT MARTIN. Histoire de la géographie et des découvertes géographiques depuis les temps les plus reculés jusqu' à nos jours. Paris. HACHELT et CIE. 1875.

The university of Amsterdam possesses in its library 23 editions of PTOLEMY of which the oldest appeared in 1511 (at Venice) and the most recent in 1704 at „Lugduni Bat. et Trajecti ad Rh." (Leyden and Utrecht).

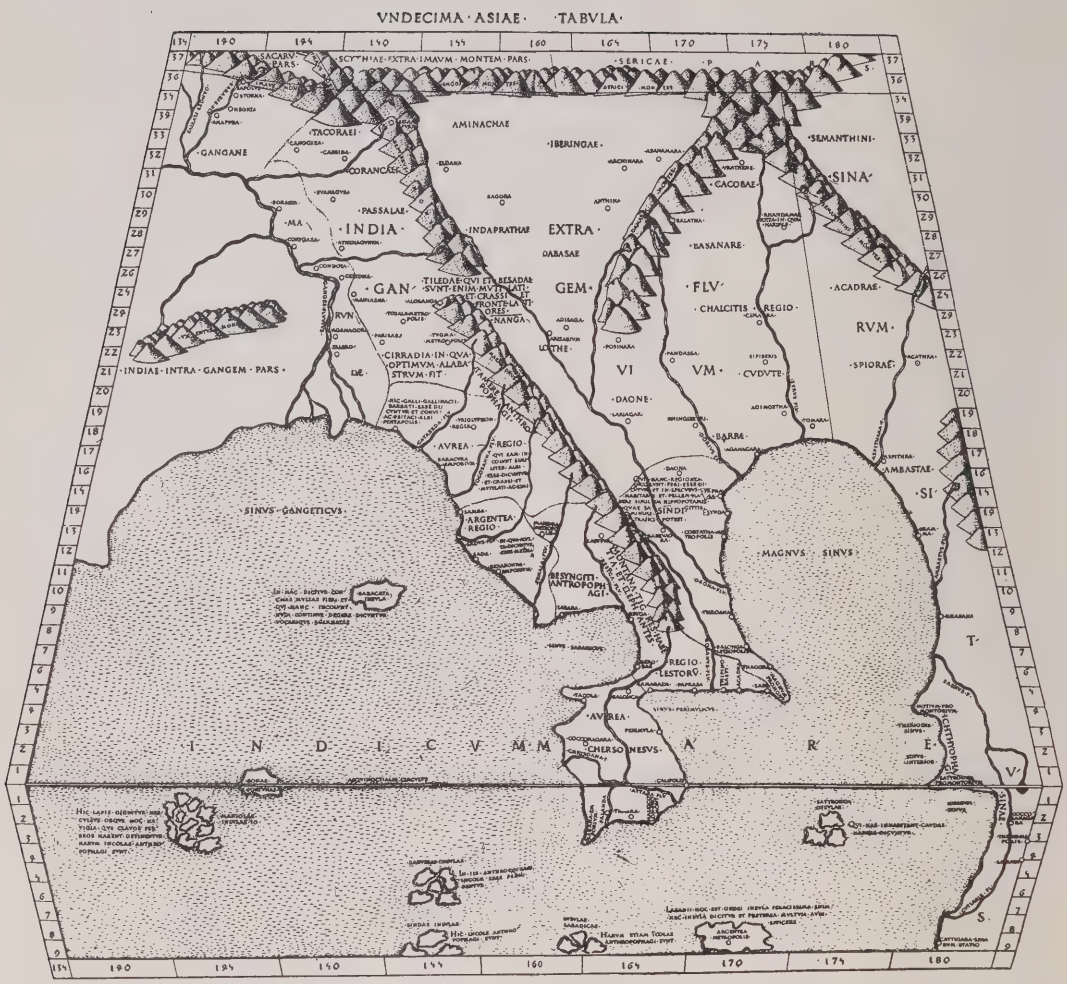
The "Historisch Scheepvaart Museum" at Amsterdam has as happy complement, the three oldest editions: Rome (1478). Florence (1480?) and Ulm (1482).

[2]) Compare also: W. P. GROENEVELDT. Supplementary jottings to the Notes on the Malay Archipelago and Malacca. Compiled from Chinese sources. T'OUNG PAO. VII. 1896. 113 and *ibid.* IV. 1893, 81.

For the voyages of FA HIAN: JAMES LEGGE. Record of Buddhistic Kingdoms, being an account of the Chinese monk FA-HIEN of his travels in India and Ceylon. With map. Oxford. 1886.

S. BEAL. Travels of FA HIEN and SUNG YUN, Buddhist pilgrims from China to India 400 and 415 A. D. With map, 1869. CHY FA WAN, FOE KOUE KI, ou relation des royaumes boudhiques. Traduit du chinois et commanté par ABEL RÉMUSAT. Augmenté par KLAPPROTH et LANDRESSE. Paris. 1836.

RAYMOND BEAGLEY. The dawn of modern Geography. London, JOHN MURRAY, 1897, p. 478—486.



PTOLEMÆUS ROMÆ 1490.

THE MALAY ARCHIPELAGO AND MALACCA (AUREA CHERSONESUS) ACCORDING TO PTOLEMY.

Next to GROENEVELDT we must at once mention the celebrated article by PELLIOT: "Deux itinéraires de Chine en Inde à la fin du VIII[e] Siècle", published in: Bulletin de l'école française d'extrême orient (BEFEO) Tome IV. 1904. There is also much information in the study by G. FERRAND, in: Journal asiatique. Tome XII. "Le K'ouen-Louen et les anciennes navigations interocéaniques dans les mers du sud".

An excellent account of the significance of Chinese sources, written in a lively, journalistic spirit, will be found in the "Indische Gids" March-November issue, 1919, from the pen of the late M. VAN GEUNS, with introduction by G. P. ROUFFAER. For later Chinese sources the above mentioned article "Tochten" in the Encyclopaedie van Ned.-Indië, 1905, by ROUFFAER, may also be consulted, together with his most recent paper in: "Bijdragen" vol. 77 1921, also mentioned above.

Now the Javano-Malay sources become more important. In the first place "Nagarakrtagama" the celebrated hymn in praise of Hajam Wuruk, the fourth King of Madjapahit, bij PRAPANCA of 1365 (Most recent edition KERN-KROM the Hague, MARTINUS NYHOFF 1919). The list of territories subject to Madjapahit contained therein, clearly shows that the whole Archipelago, from New Guinea to the Malay peninsula and Farther India inclusive, was known to the Javanese and Malay, at least by name (compare the map in the edition KERN-KROM, and the papers by ROUFFAER, NIERMEYER, VAN EERDE, KROM, WESTENENK and BLAGDEN, which all deal with this list. Also FERRAND is his "Relations" vol. 2. 1914).

Of still later date is the no less important "Pararaton" (Ken Arok) the book of the Kings of Tumapel and of Madjapahit, first published and annotated by Dr. J. L. A. BRANDES in 1896, and re-edited by Dr. N. J. KROM, Verh. Bat. Gen. v. K. en W. vol. LXII. 1920.

Since this historical source has now been made generally available by the coöperation of ROUFFAER and the French scholars, G. FERRAND

For I TSING and HIUEN TSANG the following may be consulted: I-TSING, "A record of the Buddhist religion as practised in India and the Malay Archipelago (A. D. 671—695). Translated by J. TAKAKUSU. Oxford. 1896.

H. KERN. A Chinese traveller in Sumatra. In: Tijdschrift v. Ned. Indië, 1897.

I-TSING. Voyages des pélerins bouddhistes, mémoire composé à l'époque de la grande dynastie T'ANG sur les religieux éminents qui allèrent chercher la loi dans les pays d'occident. Traduit en français par EDOUARD CHAVANNES. 1894.

Mémoires sur les contrées occidentales, traduits du Sanscrit en Chinois en l'an 648 par HIOUEN-THSANG et du Chinois en Français par STANISLAS JULIEN. Paris. 1857.

Histoire de la vie de HIOUEN-THSANG et de ses voyages dans l'Inde, depuis l'an 629 jusqu'en 645, par HOEI-LI et YEN-THSING; suivie de documents et d'éclaircissements géographiques tirés de la relation originale de HIOUEN-THSANG; traduite du Chinois par STANISLAS JULIEN. Paris. 1853.

and P. Pelliot, a mere reference to the work itself will here suffice.

Among Malay writings we must mention the "Sadjarah Malayu" (Malay Annals; translated from the Malay language, by the late Dr. John Leyden. With an introduction by Sir Stamford Raffles, London 1821). Rouffaer considers the Sadjarah Malayu to have been written about 1612. A still later date must be assigned to the "Hikajat Radja Radja Pasei", probably of the eighteenth century (compare J. C. van Eerde in T. K. N. A. G. 2e serie dl. 28).

Especially of late years all these data have been further studied and examined by numerous Dutch and French scholars, so that we are better informed concerning the conditions which obtained during this period on the celebrated route through the Straits of Malacca. It has become more and more clear that attempts to command these means of access from the first led to struggles between Nearer India, Sumatra and Java. For data we may refer to: Dr. N. J. Krom. Oration, Leiden 1919. G. Coedès, Le royaume de Crivijaya. BEEEO. tome XVIII. no. 6. 1918. G. Ferrand L'empire de Crivijaya in Journal asiatique 1922 nos 1 and 2. G. P. Rouffaer. "Was Malaka emporium".... etc. Bijdragen dl. 77. 1921.

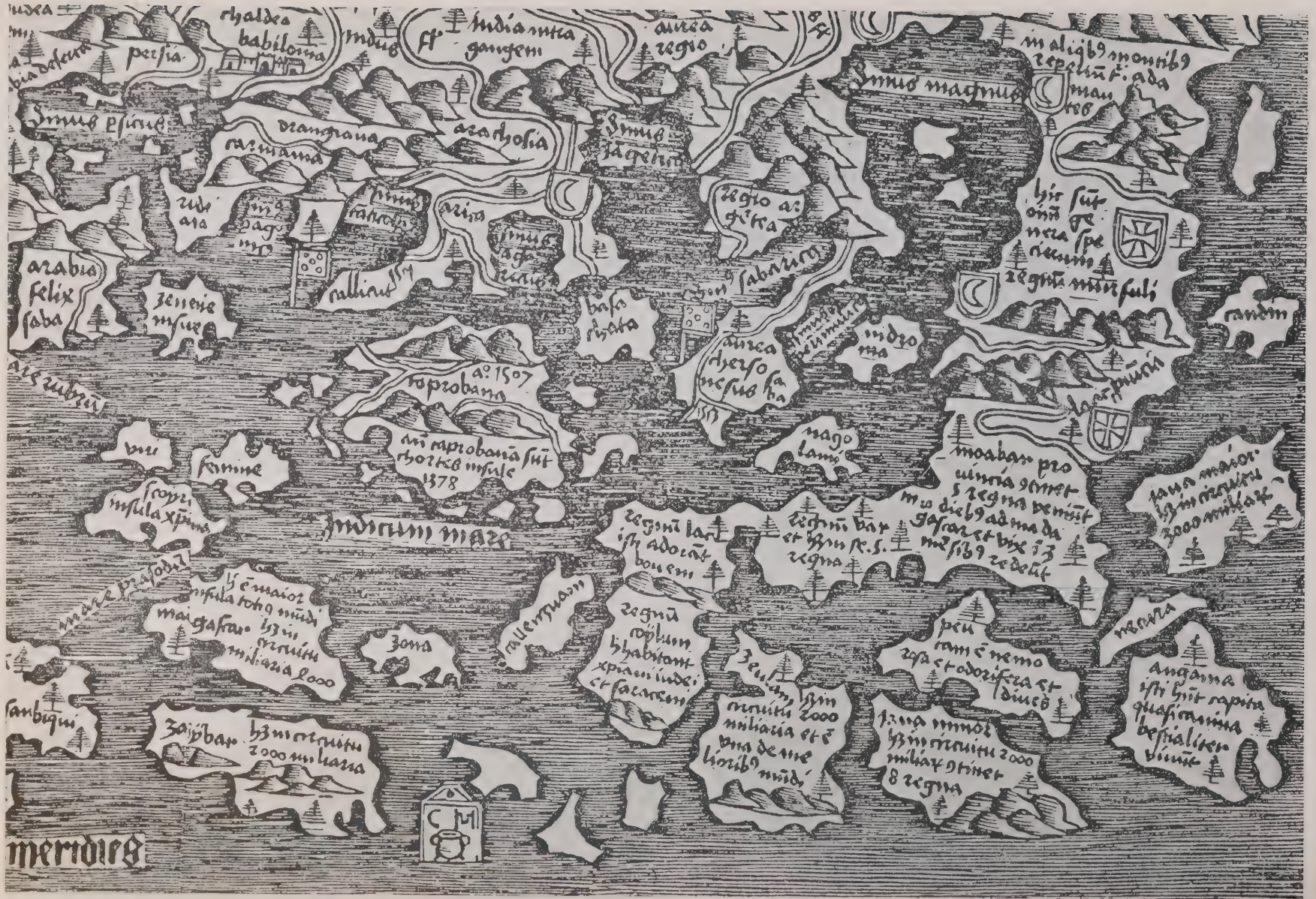
Are Javanese maps of this period known? Their existence is pretty certain (comp. S. P. l'Honoré Naber in: "De zeeën van Nederlandsch Oost-Indië". Leiden. E. J. Brill. 1922, pp. 2 and 3, and also Dr. F. C. Wieder's article "Kaartbeschrijving" (Cartography) in: Encyclopaedie van Nederl. Oost-Indië. 2nd edition. 1918). None have, however, come down to us.

Since the ninth century the archipelago was also visited by Arabians and Persians, whose writings have in some cases been preserved and made accessible by scholars to modern geographers. The work of Ibn Chordadhbeh was edited with Arabic text and French translation by prof. De Goeje in: Bibliotheca Geographorum Arabicorum. vol. VI. Leiden. 1889. G. Ferrand further deals with various Arabic and Persian accounts of voyages in his "Relations de voyages et textes géographiques arabes, persans et turcs relatifs à l'Extrême Orient du VIIIe au XVIIIe siècles traduits, revus et annotés".

A brief survey of the principal accounts by these travellers is given by Rouffaer in: Encyclopaedie van Nederl. Oost-Indië 1st edition, article "Tochten", and a sketch of the significance of the works of Islamic geographers appeared recently from the pen of Baron Carra de Vaux "Les penseurs de l'Islam". Paris. 1921. Van Geuns, in his above mentioned article in the "Indische Gids", 1919, also gives a brief, but informative survey of the writings of these travellers.

The second half of the thirteenth century brought to the west the knowledge obtained in the far East by Venetian traders. Among these

THE INDIAN ARCHIPELAGO, ACCORDING TO WALDSEEMÜLLER 1507, SHEETS 8 AND 12. REDUCED 1:3.



REPRESENTATION OF THE MALAY ARCHIPELAGO ON THE OLDEST DUTCH WORLD-MAP 1514.

PLATE IV.

MARCO POLO is the most important. His work was edited by Sir HENRY YULE and HENRY CORDIER. London 1903. [1])

SECOND PERIOD.

From the arrival of the Europeans in 1511 to the present day.

With the end of the first period the growth of our geographical knowledge of the Far East, based on direct observation by Westerners, begins. Already in 1459 Fra MAURO drew a map of the world, which showed that portion of the Malay Archipelago in which the west was most interested, viz. the Spice Islands. (Comp. ROUFFAER "Tochten".)

In the beginning of the second period occur the attempts of the Portuguese to reach India, which were entirely successful. Compare the sketch of these voyages by P. A. TIELE in "de Gids" of 1873 (p.p. 177—223.) Western Europe desired to know the surprising results of these voyages of discovery and to satisfy this desire M. WALDSEEMUELLER published a map of the world in 1507 which showed the recent discoveries. His representation of the Malay Archipelago on his world map is seen on the annexed plate III [2])

The want of a map of the newly discovered countries was also felt in Holland. It was drawn by CORNELIUS AURELIUS for the *Cronycke van Holland, Zeelandt en Vrieslant*, the so-called "Divisie" chronicle.

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[1]) Of other European travellers who visited the Malay Archipelago during this period and whose accounts of travel have come down to us we mention: Fra ODORIGO DE PORDENONE who stayed in Northern Sumatra in 1323. The description of the journey of this Italian monk occurs in RAMUSIO's "Navigationi e Viaggi".

NICOLO DE CONTI, a Venetian, seems to have been both in Java and in Sumatra, about 1423 (comp. ROUFFAER l.c. p. 393).

The description of the travels of DUARTE BARBOSA, who visited nearer India probably about 1501, was compiled at Seville in conjunction with MAGALHAES, and is also included in RAMUSIO's collection.

Finally LUDOVICO DI VARTHEMA of Bologna visited Malacca and Pedir in 1505. What he says of Java and the Moluccas is not worthy of credence. (P. A. TIELE. Bijdragen. 1877—1887. "De Europeërs in den maleischen Archipel").

[2]) For further details concerning this map and the Carta Marina of 1516, see prof. Jos. FISCHER and FR. R. VON WIESER. Die älteste Karte mit dem namen Amerika aus dem Jahre 1507, und die Carta Marina aus dem Jahre 1516 des M. WALDSEEMUELLER (Ilacomilus).

Further, Dr. C. P. BURGER in "Het Boek", 5e Jrg. 1916. "De oudste Hollandsche wereldkaart, een werk van CORNELIUS AURELIUS" (The oldest Dutch world-map, a work of CORNELIUS AURELIUS). Of that map the portion representing the Malay Archipelago was reproduced by Dr. BURGER, and the block was kindly lent by the firm of MARTINUS NYHOFF for the purposes of the present review.

EASTERN HEMISPHERE OF THE FIRST WORLD-MAP BY PLANCIUS (COPIED AFTER RUMOLDUS MERCATOR) FOR THE BIBLE EDITION OF LAURENS JACOBSZ. 1590 AMSTERDAM. IN THE POSSESSION OF THE UNIVERSITY LIBRARY.

The portion of this map representing the Far East is reproduced on plate IV. It is wholly derived from the map by WALDSEEMUELLER, as is at once evident from a comparison of the two reproductions.

During the period of the voyages of discovery by the Portuguese and Spaniards our geographical knowledge of the East grew rapidly. DIEGO RIBERO mapped the world in 1529 with the Papal line of demarcation and for a long time this Ribero type was used in further work (compare P. A. TIELE, "De oudste kaarten van den Maleischen Archipel" in: Bijdragen. 1883; F. C. WIEDER, Nederlandsche historisch-geografische documenten in Spanje, E. J. BRILL, Leiden 1915; the same in: Encyclopaedie van Ned. Oost-Indië, 2nd edition. IV. article "Kaartbeschrijving").

The highest point was reached by the map of LOPO HOMEM in 1554, which was not modified by VAZ DOURADO (1568—1580), nor by LASO (1590) (WIEDER. Encycl. p. 233).

While maps were thus developed, descriptive geography was fixed by the numerous accounts of voyages, collected by RAMUSIO and published in three volumes from 1550—1556. For a review of these consult further P. A. TIELE in his study: "De Europeërs in den Maleischen Archipel". In: Bijdragen. 1877—1887.

On the basis thus obtained the foundations of Dutch cartography of the Far East were laid in 1590. In that year PLANCIUS drew his first world-map for the Bible, which was still a faithful copy of the map of RUMOLDUS MERCATOR (plate V), but already in 1592 he prepared the largest world map then known, in 16 sheets (original at Valencia) and in 1594 a reduced edition for LINSCHOTEN's Itinerario of 1596 (plate VI). A close study of these two reproductions shows how PLANCIUS by his own study of descriptions of travel, improved his map. His portrait must not be omitted here (plate VII) and the curious print representing his lessons in geography to our sailors, given in the "Oude Zijdsch Kapel" at Amsterdam, which occurs on the title page of "De groote lichtende ofte Vyerighe Colom". 1652. ("Great Pillar of light or fire") is reproduced on plate VIII.

Together with these maps we have again the accounts of voyages, the so-called "Leeskaarten" (Reading maps). In the first place the Itinerario of JAN HUYGEN VAN LINSCHOTEN (prof. H. KERN. Itinerario voyage ofte schipvaert van JAN HUYGEN VAN LINSCHOTEN naar Oost ofte Portugaels Indien 1579—1592. Linschoten Vereeniging, The Hague, MARTINUS NIJHOFF, 1910, with Introduction by P. A. TIELE) (Voyage to East or Portuguese India).

From hence forward the work was continued with vigour. Every voyage brought new data. For the share of the Dutch in the discovery of Australia consult: Remarkable maps. II and III. The geography of

EASTERN HEMISPHERE OF THE WORLD-MAP OF PLANCIUS 1594. REPRODUCED FROM THE UNFOLDED COPY IN THE POSSESSION OF THE UNIVERSITY LIBRARY AT AMSTERDAM.

Australia as delineated by the Dutch cartographers of the XVIIth century, Amsterdam 1895. Introduction and notes to parts II and III, supplements, by E. J. HEERES, Delft. April 1899.

Further we give on plate IX a reproduction of a map, preserved in the University Library at Amsterdam, which clearly shows the share of the Dutch in the growth of our knowledge of the "Zuidland" ("Southern land") up to Nov. 24th 1642: Antoni van Diemenslant, aldereerst besylt ofte ontdekt by de schepenen Heemskerck ende Zeehaen den 24 Nov. 1642. (ANTHONI VAN DIEMEN'S land, sailed to for the first time or discovered by the ships (Heemskerck) and (Zeehaen) on Nov. 24th 1642).

Now the period also begins when the Dutch people was splendidly informed of the developments in world geography by the numerous atlasses which made their appearance. From 1648—1664 there was published by JOAN BLAEU of Amsterdam: Grooten atlas ofte werelt-beschryving, in welcke 't aerdryck, de zee, en hemel, wort vertoont en beschreven (9 volumes), Tooneel der steden (2 volumes) (Large atlas or world description, which shows the earth, the sea and the heavens described; with views of towns).

While cartography was thus cultivated with enthusiasm and artistic sense, scientific enquiry, begun towards the end of the seventeenth century, was also vigorously pursued in the first half of the eighteenth. From 1653—1702 RUMPHIUS (*"Plinius indicus"*) the first scientific naturalist, worked in Amboina. For his work reference should be made to the "RUMPHIUS-Gedenkboek", a memorial volume published by the Colonial Museum of Haarlem, on June 15th 1902, in honour of this investigator.

On the latter's work is also based the encyclopaedic work of FRANÇOIS VALENTIJN: Oud- en Nieuw Oost-Indien, which appeared at Dordrecht in 1724.

The second half of the eighteenth century is characterized by a stagnation of enquiry, but the spirit was quickened once more towards the close of this century. In June 1778 the "Bataviaasch Genootschap van Kunsten en Wetenschappen" was founded. This society did much for the extension of geographical knowledge of the archipelago in the first years of its existence, later under RAFFLES and really until 1850, the year when the "Natuurkundige Vereeniging" was started in the Dutch Indies. The "Verhandelingen" as well as the "Tijdschrift" and "Notulen" (minutes) of this period show the work which was done; they contain valuable articles which are still of importance to-day.

Thus ends the period of the East Indian Company to which Holland, in spite of things to the contrary, may look back with pride, especially as regards the growth of knowledge. The latter result, sometimes not recognized, has become more evident of late years through the publications of the Linschoten Vereeniging; through the work of the firm of FREDERIK

MULLER and its collaborators, HEERES and WIEDER; through the firm of MARTINUS NYHOFF and men like: P. A. LEUPE, P. A. TIELE, Jhr. Mr. J. K. J. DE JONGE, Mr. J. A. VAN DER CHIJS, Dr. J. W. IJZERMAN, Dr. G. P. ROUFFAER, Dr. H. T. COLENBRANDER, J. F. L. DE BALBIAN VERSTER and many others.

RAFFLES supplied a vigorous continuation to the results obtained towards the end of the eighteenth century. In conjunction with JOHN LEYDEN, JOHN CRAWFURD and the Dutchmen H. W. MUNTINGHE and J. C. CRANSSEN great things were done for the extension of our knowledge as is shown by the following publications: The History of Java, London 1817, by RAFFLES; The History of the Indian Archipelago, Edinburgh 1820, three volumes, by CRAWFURD; transformed thirty-six years later into his "Descriptive dictionary of the Indian islands and adjacent countries" (London 1856.)

Soon after the restoration of Dutch independence the work was actively continued by the Dutch. CASPAR GEORG CARL REINWARDT [1]) was appointed in 1815 as chief of the investigation of Java and the neighbouring islands and in 1820 the "Natuurkundige commissie" was appointed.

The members of this committee accomplished their task with much enthusiasm and extreme exertion. For their work we may refer to Dr. M. J. SIRKS, Indisch Natuuronderzoek. Published by the "Koloniaal Instituut", 1915. Here we merely mention the work of S. A. L. SCHWANER, Borneo. Amsterdam 1853. (Published by the Kon. Inst. v. Taal-, Land- en Volkenkunde [1]).

One of its members FRANZ WILHELM JUNGHUHN was sent to the Indies as army surgeon, and his work was of such great importance to physical geography, that he may safely be regarded as the founder of the physico-geographical investigation of the Archipelago. For his life and works we refer to "Gedenkboek FRANZ JUNGHUHN" 1809—1909. The Hague, MARTINUS NIJHOFF. 1910. Among his works we mention: Die Battalaender auf Sumatra. Berlin 1847, and: Java, zijne gedaante, zijn plantentooi en inwendige bouw. The Hague 1853. With atlas and map of Java, published separately in 1855 at Breda.

Maps were also brought to a higher state of perfection during this period, as is shown by the publication of some atlases of which the

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[1]) Consult for his life and works P. J. VETH's Ontdekkers en onderzoekers. Zevental levensschetsen, Leiden 1884.

Further: „Reis naar het oostelijk gedeelte van den Indischen Archipel in het jaar 1821 door C. G. C. REINWARDT, Amsterdam 1858.

[1]) We may further mention: Verhandelingen over de natuurlijke geschiedenis der Nederlandsche overzeesche bezittingen door de leden der natuurkundige Commissie in Indië en andere schrijvers, 1839—1844.

Dit is des Hemels, Maeds. en Zees bejobruyde daar
Het Nederland door vlugt van 't eene Ruck int aar;
De wijser vinde weyh des Hemels sjo door leer:
Als leren, daer van geeft Sem Alleman de Eer:
Int Hemels, Maeds; tot Zee, wel luckich Nederlant
Indien het volgde maer dat Plantius inplant.
Ende is Overleden int Iaer 1622. den 15 May. Out 70 Iare.

PETRUS PLANCIUS
AFTER THE COPPER ENGRAVING IN THE POSSESSION OF THE REMONSTRANT REFORMED CHURCH AT AMSTERDAM.

best and most important was published by P. Baron MELVILL VAN CARNBEE and W. F. VERSTEEG. Batavia 1853 – 1862. Second edition 1870 [1]).

From this period also dates the foundation of the *Koninklijke Natuurkundige Vereeniging* in the Dutch East Indies, to which casual reference has already been made. Led by P. BLEEKER, this young Society developed great vigour as shown by numerous important articles in its Journal (Natuurkundig Tijdschrift voor Nederlandsch Indië 1850 – present day) which are still of importance to the geography of the Archipelago.

In the mother country there was founded in 1851 at Delft "Het Koninklijk Instituut voor de taal- land- en volkenkunde in Nederlandsch Indië". The important "Bijdragen" which are published by the Institute have already been repeatedly referred to. With the Institute's numerous separate publications they constitute an important source of geographical knowledge.

Space does not permit us to mention the various expeditions, which visited the Archipelago in the first half of the nineteenth century and we must refer for them to the above quoted work of SIRKS (Indisch Natuuronderzoek) and to L'HONORÉ NABER in: De zeeën van Nederlandsch Oost-Indië. Leiden E. J. BRILL 1922. We cannot, however, omit mention of the voyage of CHARLES DARWIN (in H. M. S. Beagle 1831 – 1836) which became of great importance for a knowledge of coral forms [2]), also in our Archipelago, although DARWIN did not visit it. Similarly we may refer to the far-reaching results of WALLACE's visit [3]) which again drew attention to the great difference between the Eastern and the Western

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[1]) For other maps of the first half of the nineteenth century consult J. Æ. C. A. TIMMERMAN, in: Encyclopaedie van Nederlandsch-Indië 1905, article "Kaartbeschrijving" p.p. 150 – 175. There will also be found a bibliography.

Further in the "Repertorium op de Koloniale Literatuur etc" by J. C. HOOYKAAS, part I, Amsterdam 1874, under numbers 1338 – 1725 there is a detailed list of all the maps of Eastern Asia which had been discussed in periodicals previous to 1874.

[2]) Consult further on this point: G. A. F. MOLENGRAAFF in "De zeeën van Nederlandsch Oost-Indië. E. J. BRILL. Leiden 1922, pp. 316—337, maps IV and V. L. VAN VUUREN, Het Gouvernement Celebes. Proeve eener monographie. Batavia 1920, pp. 100—150. B. G. ESCHER, Atollen in den Nederlandsch Oost-Indischen Archipel. Meded. Enc. Bureau XXII, 1920. J. F. NIERMEYER, Barrière-riffen en atollen in den Oost-Indischen Archipel. T. K. N. A. G. 1911, pp. 877—894.

[3]) WALLACE remained in the East from 1854 to 1862. Consult: The Malay Archipelago. The land of the Orang Utan and the Bird of Paradise. London, 1864. Dutch translation by P. J. VETH, Amsterdam 1870—1871. The following two papers by WALLACE are also of great interest: "On the physical geography of the Malay Archipelago", in: Journal of the Roy. Geogr. Soc. and "On the zoological geography of the Indian Archipelago. Translations into Dutch by P. J. VETH, appeared respectively in: "Tijdschr. v. Ned. Indië". 1865, and in: "De Gids". 1864.

Consult further "De Zeeën". Geologic Maps I, II and III. The Monograph on Celebes pp. 6 – 55 and the papers by J. F. NIERMEYER and R. SCHUILING in: Tijdschr. K. N. A. G. 1897 (758 – 765) and 1888 (523 – 560).

FROM THE TITLE PAGE OF "GROOTE LICHTENDE OFTE YVERIGHE COLOM", AMSTERDAM 1652.

portions of the Archipelago, this time on a geological and biological basis, on which WALLACE's line of demarcation depends.

Now comes the modern period. The outlines of the map, which up till then had been more or less loosely fixed, were defined on a scientific basis. In 1857 prof. dr. J A. C. OUDEMANS was put in charge of the *geographical service* and in 1861 the triangulation proper was begun. A start was made with Java. OUDEMANS published the results of his work in "Die Triangulation von Java" which was completed in 1900 and contains in six sections all the data concerning the two networks of triangles which were measured.

In May 1883 the triangulation of Western Sumatra was begun and in 1895 that of Southern Sumatra. The former was finished in 1896, the latter in 1906, in which year the triangulation of Djambi was begun. In 1904 the connexion between the nets of Sumatra and of Java had been established under the direction of prof. dr. J. J. A. MULLER. The triangulation of the East coast of Sumatra was begun in 1907 and that of Celebes in 1910 (compare J. J. A. MULLER. In: Catalogus Kon. Ned. Aardr. Gen. Tentoonstelling Amsterdam. 1913. pp. 27-34).

The altitude of the various points of the triangulation was measured trigonometrically. As a basis for these measurements gauge observations were made in several places in order to obtain the mean level of the sea.

In those districts in which the nature of the country made triangulation too difficult, positions were determined astronomically. Thus the survey of the western portion of Borneo depends on 103 points located in this manner, and that of the flat south eastern portion of Sumatra on 64 points similarly fixed.

The geographical latitudes of the astronomical stations are derived from circum-meridian observations, and their differences in longitude were determined by chronometers. In 1922 a start was made with the astronomical location of various points in the flat low portion of Eastern Central Sumatra, using for the determination of longitude wireless time signals sent out by the station Malabar (Western Java).

In this way a brief account has been given of the development of the mathematical basis of the survey of the Dutch Indies. Space does not permit us to deal in the same manner with the development of the Topographical service as a whole, although the latter is closely related to the growth of our geographical knowledge. The present method of working is sketched in Appendix I by the head of this service, colonel A. VAN LITH [1]), recently retired.

[1]) The course and progress of the Hydrographic Survey of the Archipelago is sketched in Appendix II by Naval Captain J. LUYMES, chief of the division Hydrography of the "Departement van Marine" (Admiralty). Both appendices are accompanied by a map showing the present position of the survey. (Chart I and II).

CHART ABOUT THE MIDST OF THE 17TH CENTURY,
PUBLISHED BY HUGO ALLARDT. AMSTERDAM (1640—'70 OR '80). IN THE POSSESSION OF THE
UNIVERSITY LIBRARY AT AMSTERDAM.

PLATE IX.

We must not, however, omit a reference to the labours of a former chief of the survey, Captain J. J. K. Enthoven who between 1886 and 1895 succeeded in mapping the whole of the "Westerafdeeling" of Borneo, on the basis of points fixed astronomically by himself. (comp. J. J. K. Enthoven, Geographische plaatsbepalingen T. K. N. A. G. 1903 pp. 825—852). This work chiefly owes its geographical significance to the fact that Enthoven has supplied the very necessary geographical explanations of the topographical map in a large work in two volumes: Bijdragen tot de geographie van Borneo's Westerafdeeling, Leiden, E. J. Brill, 1903.

We further call attention to another publication started under his auspices: Jaarverslag van den topographischen Dienst. 1906 to date, containing data important to geographers.

In the mother country geographical investigation was meanwhile being stimulated by prof. P. J. Veth. As early as 1854—1856 there had appeared his work: Borneo's Westerafdeeling, which was followed between 1875 and 1884 by the four volumes of his masterly work: Java, geographisch, ethnologisch, historisch [1]). Under his direction, or rather as a result of his coöperation and lively interest there appeared also, between 1859 and 1869, the Aardrijkskundig en Statistisch woordenboek van Nederlandsch Indië, which replaced the Indian portion (1839) of the Aardrijkskundig Woordenboek van Nederland by A. J. van der Aa. In 1873 the Koninklijk Nederlandsch Aardrijkskundig Genootschap (Royal Dutch Geographical Society) was founded, with Veth as its first president. As early as 1876 the publication of the "Tijdschrift" was started, which in course of time has become the most important depository of geographical knowledge of the Malay Archipelago.

In 1875 preliminary steps were taken towards the equipping of the first expedition, sent out by the Society with government aid. Its results have been recorded in the work: Midden-Sumatra. Reizen en onderzoekingen der Sumatra-expeditie, uitgerust door het Aardrijkskundig Genootschap, 1877—1879, beschreven door de leden der expeditie onder toezicht van prof. P. J. Veth.

This opened the series of expeditions and publications of the Society, which were later to be continued in coöperation with India itself. The connecting link in this coöperation was Melchior Treub.

On his initiative the "Maatschappij tot bevordering van het natuurkundig onderzoek der Nederlandsche koloniën" was founded, and in India the "Indisch Comité voor wetenschappelijk onderzoek"; in happy coöperation with these bodies the geographical investigation of the Archipelago was

[1]) Re-edited and augmented, 1896—1907 by Joh. F. Snelleman and J. F. Niermeyer.

continued, but even before forces were joined, an expedition to the Key islands had been decided on:

Verslagen van de wetenschappelijke opnemingen en onderzoekingen op de Key-eilanden, gedurende de jaren 1889—1890 ingesteld door H. O. W. PLANTEN en C. J. M. WERTHEIM, in opdracht van het Kon. Ned. Aardr. Gen. met eene kaart der Key-eilanden en een ethnographischen atlas van de Zuidwester- en Zuidooster-eilanden. Leiden. E. J. BRILL. 1893.

Then however the efforts of TREUB and of SERRURIER began to succeed. The expeditions to Borneo begin:

Borneo-Expeditie. Geologische verkenningstochten in Centraal-Borneo 1893—94), door Dr. G. A. F. MOLENGRAAFF. Leiden. E. J. BRILL. 1900.

In Central-Borneo. Reis van Pontianak naar Samarinda, door Dr. A. W. NIEUWENHUIS, I en II. Leiden. E. J. BRILL. 1900. Both works were published by the "Maatschappij".

Quer durch Borneo. Ergebnisse seiner Reisen in den Jahren 1894, 1896—97 und 1898—1900 von Dr. A. W. NIEUWENHUIS unter Mitarbeit von Dr. M. NIEUWENHUIS—VON UXKUELL—GUELDENBRANDT. Zwei Bände. E. J. BRILL. 1904—1907.

Sumatra also continued to engage attention. Under the leadership of J. W. IJZERMAN a journey of exploration was made across Sumatra, in connexion with the possible export of coal eastwards from the Ombilien coal field which had meanwhile been discovered. The results are reported in the work:

Dwars door Sumatra. Tocht van Padang naar Siak onder leiding van den Hoofdingenieur J. W. IJZERMAN, beschreven door de leden der expeditie J. W. IJZERMAN, J. F. VAN BEMMELEN, S. H. KOORDERS en L. A. BAKHUIS. 1895.

In connexion with the stay in the Indies of prof. MAX WEBER (1888—1889 with Mrs. Dr. WEBER—VAN BOSSE), prof. Dr. A. WICHMANN was enabled by the Geographical Society to undertake a voyage to Celebes and some eastern islands. An account of this is given by the latter in: Bericht ueber eine im Jahre 1888—1889 im Auftrage der Niederlaendischen geographischen Gesellschaft ausgefuehrte Reise nach dem Indischen Archipel (T. K. N. A. G. 1890, pp. 907—994).

Next came the turn of New Guinea; Prof. WICHMANN first directed operations here, in 1904. The important results of various Dutch expeditions, sent to this large island under the auspices of the above-named bodies, have been collected in a work appearing since 1909 entitled "Nova Guinea" which will be present at the Sydney conference.

On June 9th 1907 there moreover began a military exploration of New Guinea which continued to January 1915. The results are reported in: Verslag van de Militaire exploratie van Nederlandsch Nieuw Guinea. 1907—1915, met 9 kaarten, 10 schetsen en 166 foto's. Weltevreden 1920.

An idea of the work done is obtained by a juxtaposition of any of the older maps with the sketch map of New Guinea in four sheets, on a scale of 1 : 1,000,000 published in 1919. We have only space to mention the chief incidents in this work of exploration. On November 8th 1909 LORENTZ, VAN NOUHUIJS and HABBEMA reached the WILHELMINA summit at a height of 4461 metres, and thus crossed the snow line. On January 30th 1913 Dr. WOLLASTON reached the snow line on the CARSTENS summits.

FRANSSEN HERDERSCHEE with HUBRECHT reached the WILHELMINA summit in 1913. On December 4th 1921 HUBRECHT — member of the expedition KREMER — reached the WILHELMINA summit, this time from the North, and he was therefore the first to cross New Guinea (We may further consult: Informations of the Encyclopaedic Bureau. Issue XI. 1916. The results obtained of Military Exploration work in Dutch New Guinea).

The Eastern portion of the Archipelago with its phantastically shaped islands, its crumbled island arcs and deep basins now began to claim more and more attention.

Already in 1893 the cousins P. and F. SARASIN began their voyages of exploration there, which continued to 1896 and were resumed in 1902—1903. The chief results are to be found in their works: "Materialien zur Naturgeschichte der Insel Celebes. Wiesbaden 1901, 1901 and 1905. 3 Bde and in: Reisen in Celebes ausgeführt in den Jahren 1893—1896 und 1902—1903. Wiesbaden 1905. 2 Bde.

To this period also belongs the most important of all Dutch voyages, viz: THE SIBOGA EXPEDITION, an account of which is given in another pamphlet of this series. The attractive journal of this voyage, written by Mrs. WEBER—VAN BOSSE, was published by E. J. BRILL at Leiden in 1905.

In 1907 the "Verein für Geographie und Statistik zu Frankfurt am Main" sent out the Sunda expedition under the leadership of Dr. JOH. ELBERT; its results were published in:

Die Sunda-expedition des Vereins für Geographie und Statistik zu Frankfurt am Main von Dr. JOH. ELBERT. Frankfurt am Main 1911. 2 Bde.

Once more Celebes became the centre of interest. The Kon. Nederl. Aardr. Genootschap enabled the mining engineer E. C. ABENDANON to undertake a journey to Central Celebes in 1909 and 1910.

Its geographical and geological results are embodied in his large work in four volumes: Geologische en geographische doorkruisingen van Midden-Celebes (1909—1910) door E. C. ABENDANON. Leiden. E. J. BRILL. 1915, 1916 (Atlas), 1917 and 1917—1918.

Here is the place to point out the important part played by Dutch missionaries in the extension of our knowledge of the Archipelago. Numerous papers in periodicals and separate works have been written by those engaged in missionary work in the various islands. It is impossible

to mention here all who have taken part in this work. In the "Encyclopaedie van Ned.-Indië, 2nd edition 1921, an account of missionary journals will be found in the article "Tijdschriften" on pp. 489—493.

Of separate works we must mention: N. Adriani en Alb. G. Kruyt De Bareë-sprekende Toradja's van Midden-Celebes. 1 en 2. Land- en Volkenkunde. Batavia. 1912.

Geographical knowledge also owes much to the officials of the civil service and to the officers of the Army and Navy. Both in the "Tijdschrift voor het Binnenlandsch Bestuur", now "Koloniaal Tijdschrift", and in the "Militair Tijdschrift van Ned.-Indië", numerous data have been published about remote regions of the Archipelago, while many officials of the civil service and members of other services are among the writers in existing geographical journals. [1])

As a result of all this, geographical literature is scattered over a large number of periodicals; fortunately this inconvenience is countered by an important work started by J. C. Hooykaas and W. N. Du Rieu, and vigorously continued by A. Hartman, W. J. P. J. Schalker and W. C. Muller. This work, general known as the "Repertorium of Hooykaas and Hartman", is a valuable guide to the ever-increasing flow of papers in journals and of Government publications. The fifth volume, dealing with the literature of the years 1916—1920, was recently published at the Hague by Nijhoff.

The Government further started in 1910 under the "Departement van Binnenlandsch Bestuur", an "Encyclopaedic Bureau" which was charged with the task of furnishing encyclopaedic descriptions of the various islands and territories. Some twenty eight "Mededeelingen" have since been published, generally accompanied by maps and photo's. Further an atlas of the outlying districts ("Buitengewesten") was begun, of which 18 maps have so far appeared. Outside the series of "Mededeelingen" there appeared the first volume of a monograph of the "Gouvernement Celebes" by L. van Vuuren, Uitgave van het Encyclopaedisch Bureau. Weltevreden 1920.

About the same time the Department of the State Rail- and Tramways of the Dutch Indies began the publication of a series of "Mededeelingen" which in addition to technical communications contain good descriptions of the countries surveyed, together with maps and photo's. The latest report of this series, dealing with the division of Menado, appeared as no. 18 in 1922.

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[1]) Special mention is required for the excellently edited "Zeemansgids voor den Oost-Indischen Archipel', published by the "Ministerie van Marine, Afdeeling Hydrographie". It contains a number of articles of geographical interest, together with a large number of views of the coasts described, taken from the sea.

The investigation of the soil is in the hands of the Department of Agriculture. Dr. JULIUS E. C. MOHR has published numerous papers on the problem of weathering and has recently collected the results in his book: De grond van Java en Sumatra. Amsterdam. J. H. DE BUSSY 1922.

It cannot be denied, however, that the physico-geographical investigation of the Archipelago (apart from meteorology and seismography) has been somewhat neglected. After the work of JUNGHUHN, the only source of knowledge on this subject is the "Jaarboek van het Mijnwezen" (Yearbook of the Department of Mines), and for Java only, the work of VERBEEK and FENNEMA, referred to elsewhere in this series of reviews. In the same connexion we must, however, also call attention to the work of W. VOLZ, Nord Sumatra I. Die Bataklaender. II. Die Gajolaender. Berlin 1909 and 1912.

As has been pointed out, during the last decades the Government and its institutions have furnished valuable contributions to our geographical knowledge of the Archipelago. But meanwhile the "Genootschap", the "Maatschappij" and the "Indisch Comité" have continued their labours during that period.

The fortieth anniversary of the foundation by the "Genootschap" was celebrated at Amsterdam in September and October 1913 by an exhibition which furnished a much better illustration of the great progress of our geographical knowledge of the Dutch Indies, than is possible by the written or spoken word. The catalogue contains a number of articles by scholars and by men who have taken an active part in investigation on the spot.

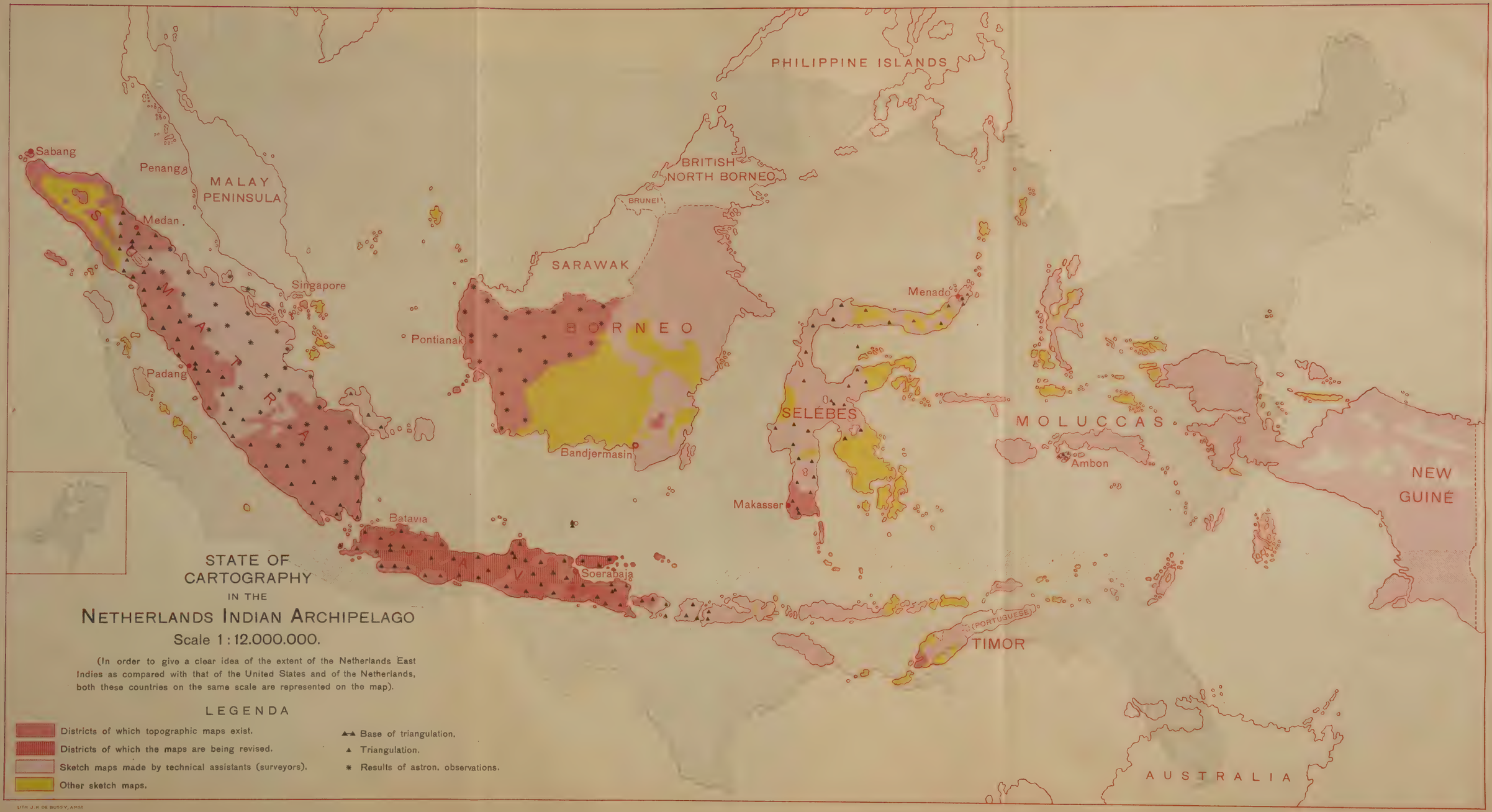
One of the exhibits was the first geological sketch map of the Dutch Indies, prepared by E. C. ABENDANON on a scale of 1 : 2.000.000 under the auspices of the Kon. Ned. Aardr. Genootschap.

Soon afterwards the world war broke out, but this event only caused investigation to be restricted and postponed, not to be abandoned.

The committee for expeditions of the Genootschap advised the investigation of the islands between Celebes and New Guinea (T.K.N.A.G. 1914 pp. 360 and 364). This investigation was indeed started, with the coöperation of the "Maatschappij" and of the "Indisch comité", in September 1917 in Ceram by the geologists L. RUTTEN and W. HOTZ, and went on till June 1919. Between these dates the work was frequently reported on in the "Tijdschrift" and the reports are also of interest to geographers.

In 1920 the investigation of the island Buru was also begun; towards the end of that year GERHARD HENNY and L. J. TOXOPEUS arrived in India. Their first report appeared in the "Tijdschrift" for 1922, p. 597.

On January 15th of the same year the most recent scientific expedition started for New Guinea, equipped by the "Indisch comité" in con-



STATE OF CARTOGRAPHY IN THE NETHERLANDS INDIAN ARCHIPELAGO

Scale 1 : 12.000.000.

(In order to give a clear idea of the extent of the Netherlands East Indies as compared with that of the United States and of the Netherlands, both these countries on the same scale are represented on the map).

LEGENDA

- Districts of which topographic maps exist.
- Districts of which the maps are being revised.
- Sketch maps made by technical assistants (surveyors).
- Other sketch maps.

- ▲▲ Base of triangulation.
- ▲ Triangulation.
- ✱ Results of astron. observations.

LITH. J. H. DE BUSSY, AMST.

junction with the "Maatschappij", and first led by staffcaptain A. J. A. VAN OVEREEM later on by Naval commander J. H. G. KREMER. The object of this expedition is more particularly the investigation of the region between the ROUFFAER- and IDENBURG rivers on the one hand, and the Nassau mountains on the other. Among the members of the expedition are Naval commander J. H. G. KREMER, for astronomy, meteorology and topography; Dr. P. F. HUBRECHT for geology; Jhr. W. C. VAN HEURN for zoology; Dr. H. J. LAM for botany; comptroller J. JONGEJANS (of the Civil Service) for Ethnology; Dr. H. J. T. BIJLMER for anthropology; H. DE ROOK, of the Army Medical Service; Capt. VAN ARKEL, Lieuts. K. DROST and J. KOOY of the military escort; Lieut. J. DROOG for wireless telegraphy.

The anthropological results of the expedition have already been published by Dr. BIJLMER in the above mentioned work "Nova Guinea".

In June 2nd 1923 the Royal Dutch Geographical Society celebrated the fiftieth anniversary of its foundation. In honour of this jubilee the above-mentioned work: "De zeeën van Nederlandsch Oost-Indië" was published in 1922 (Leiden, E. J. BRILL).

Finally we must mention two funds, administered by the "Genootschap" from which the costs of geographical and related investigations, and of scientific publications, have repeatedly been defrayed. They are "Het Veth-fonds" founded in 1902 and "Het Junghuhn-fonds", founded in 1909 (Tijdschrift 1909, p. 1026).

On the occasion of the fortieth anniversary of its foundation, Messrs. E. HELDRING and H. C. REHBOCK presented to the council of the Society the die of a gold medal, to be awarded for meritorious work in geographical science. On the advice of Dr. F. C. WIEDER there were chosen as emblems of this medal the portrait of PLANCIUS and the well-known representation of the sailing of the first Dutch fleet for Java.

The first award of the medal was made to Dr. J. W. YZERMAN who retired from the presidency of the Genootschap in 1921; he was the leader of the "Dwars-door-Sumatra" expedition, already referred to, and has of late years guided the Genootschap and thereby promoted our knowledge of the geography of the Dutch East Indies.

APPENDIX I.

The Cartography of the Dutch East Indies

by A. VAN LITH.

The Asiatic colonies of the Kingdom of Holland lie between lat. 6° N. and 11° 15′ S. and between longit. 95° and 141° East of Greenwich. Leaving out of account the smallest, there are about 1700 islands,

constituting the territory of the Dutch Indies and extending over seventeen degrees of latitude and 46 degrees of longitude, i.e. over more than one eighth of the earth's circumference.

Of this territory, having a total area of 1.9 millions of square kilometres (740,000 square miles) only a very small portion (about 3 %) can still be regarded as "terra incognita". This is situated in the almost inaccessible mountain region of New Guinea, whose summits reach a height of 5000 metres (nearly 17000 feet) above sea level.

The portions indicated on the map by *yellow colour* are those, of which sketch maps exist, drawn from data chiefly supplied by officers of the civil service and of Army and Navy, or leaders of scientific expeditions. These portions constitute 16 % of the whole territory.

That portion of the map which is indicated by *red colours* (about 81 % of the whole) is cartographically sufficiently well known, although only one third of this is mapped in a manner comparable with that of European countries.

From this we can draw the conclusion that the topographical survey of the Dutch-Indian Archipelago may be considered completed for rather more than one quarter of the whole.

The head of the "topographical service" belonging to the army, is a superior officer who may reach the rank of colonel. The personnel of this service, in as much as it is concerned with surveying, consists of 32 officers or civilians of equivalent rank, 73 non-commissioned officers acting as surveyors, 26 civilian topographers who rank above the latter, and finally 183 native topographers and 105 native draughtsmen.

The personnel of the five surveying brigades has a strength of 10 officers, 42 European and 35 native surveyors and 14 native draughtsmen. The training brigade consists of 3 officers, 18 European civilian and military surveyors, 8 native topographers and 2 native draughtsmen, and of pupils in training.

The area given to a brigade for survey, is divided into "polygons" varying in size from 25 to 100 square kilometres (10—40 square miles), according to their topographical nature and the scale of the map. The survey of the borders of these polygons (as far as possible roads and other natural boundaries) is carried out with great care by the best surveyors and the results are interpolated on squared paper between the triangulation points. The polygons are then entrusted to the younger surveyors, who begin by traversing their polygon and subdividing it through the survey of subsidiary roads and field paths; they then survey all paths, rivers, brooks and any other details, of whose representation the scale of the map allows. The border roads are measured with theodolite and chain (or tape); internal measurements are made with the "boussole

tranche montagne", which is also adapted for measurements of distance. The results are carefully noted in the log and then transferred to squared paper.

The height of every point above the plane of comparison is also determined and represented on the map by contours and bench marks. After all the measurements have been plotted, the contours must be joined up according to the nature of the country, for which purpose the surveyor again traverses the area taking the map with him.

The amount of work which an experienced surveyor can accomplish in an area with much detail, may be put at 6 to 7 square kilometres ($2^1/_2$ square miles) per month, for a scale of 1:25000. In flat country with little detail a distinctly greater rate can be attained, likewise if a smaller scale is selected.

To give an idea of the annual rate of progress, it may be stated that during the year 1921 about 17000 square kilometers (6700 square miles) were surveyed and mapped, chiefly on the islands outside Java. In addition rough surveys were made by a dozen native explorers in a few islands which for the present are not considered worth surveying in detail. The surveys in Java refer to a revision of the existing map. The great cultural development and dense population (267 inhabitants per square kilometer, 685 per square mile) demands a continual revision of the survey to keep the map up to date. Arrangements have been made to secure a regular revision of the cartographical data of Java (and Madura) at intervals of 10 years.

Outside Java the survey is being carried on in Sumatra (by three brigades) and in Southern Celebes (one brigade).

A few details may be added concerning the methods of projection and the scales employed in mapping.

In the older surveys there was no question of any definite method of projection. Not until 1864 FLAMSTEED's projection was adopted, which was replaced in 1870 by BONNE's very similar projection. For each division of Java a separate system of coördinate axes was then selected, and the coördinates of the triangulation points were calculated in respect to these. The disadvantages of this method, for instance owing to the deficient joining up of the various divisions, led for the survey of Sumatra's West-coast in 1886 to the adoption of a polyhedron projection. In this the area is subdivided by parallels and meridians at intervals of 20' into trapezium shaped pieces (so called degree section sheets) which are each referred to a plane by a conformal conical projection.

The same method of projection is now being used for the mapping of the rest of Sumatra, of Celebes and of the island Bali.

Only for New-Guinea and for sketch maps of other smaller islands

a MERCATOR projection is being used, which was formerly (1886—1895) also employed in the survey of the Western division of Borneo.

In the survey of Sumatra's West Coast the scale was still 1 : 80.000 for a degree section sheet and 1 : 20.000 or 1 : 40.000 for its component detailed sheets; in the resurvey of Central Java and of all areas which have been resurveyed in the last twenty years, the scale of 1 : 100.000 was however adopted for degree section sheets.

Further all detailed sheets of Java are mapped on the scale of 1 : 25000, except a few mountainous districts, devoid of economic importance, which are mapped on a smaller scale.

In the islands outside Java where the need of good trustworthy general maps is greater than that of detailed sheets (whose preparation would require six or eight times as much labour) a map is at once prepared on a smaller scale, as in Southern Sumatra, where the scale of 1 : 100.000 is generally employed. In the survey of Sumatra's East Coast and of Celebes the scale is generally 1 : 200.000 and only the economically important areas are surveyed with a view to a map of 1 : 100.000 or 1 : 50.000.

For sketch maps of little-known districts the scales of 1 : 250.000, 1 : 500.000 and 1 : 1.000.000 are frequently employed (New Guinea).

To all maps, in which the mountains are indicated by contours, the rule applies that the difference in height between two successive contours bears a constant ratio to the scale of the map, being in meters the two thousandth part of the scale.

While we have been so far concerned with the regular topographical survey of the Archipelago, it seems desirable to refer to another important cartographic undertaking, viz. the survey of the agricultural land of the populations of Java, Madura and a few other islands.

Whereas the work for the registration of property in the Dutch Indies is carried out by a separate (civilian) service, that necessary for the revenue records is the task of the topographical service. During the years 1906 to 1918 inclusive, special revenue survey maps on a large scale (1 : 5.000) were prepared for the whole of Java and Madura, while for portions of the Southern and Eastern divisions of Borneo and for the islands of Bali and Lombok such maps are in a state of preparation.

The staff required for the revenue records was partly trained since 1903 and consists of 4 officers, 25 European surveyors and 228 native topographers and draughtsmen. On the average about 6000 square kilometres of land has been mapped each year for revenue purposes.

It is further proposed to introduce the land tax regulations into the principal other islands of the Archipelago, so that the work of the topographical service will be considerably extended.

The results of the land tax survey are utilized for the preparation or (in Java) revision of the topographical detailed sheets.

In addition to the topographical service, other branches of the Government service undertake surveys, but of smaller extent and of a special technical nature. The principal ones are those for property registration, those of the forestry and mining services and those required for railways and irrigation works. A permanent commission, in which the various service branches are represented, ensures good coöperation and the utilisation of each other's data.

We may now refer to the way in which the results of the topographical service are reproduced and made available to the public.

In the central office of the service the maps drawn by the brigades are collected, checked and made suitable for reproduction. The data are utilized for the preparation of the various general maps of the Archipelago and its islands or subdivisions. In the case of regions which are not yet considered suitable for survey, the data are systematically collected from charts and from the sketches of officials of the civil service, military patrols, explorers or from periodicals and books and are worked up for sketch maps which can be published as soon as occasion for them arises.

The printing of the maps takes place in the topographical institute. For the principal colours of detailed sheets, and of military and sketch maps, photolithography is employed. For the topographical survey maps on the scale of 1 : 100,000 the principal colours are generally engraved on stone and transferred to other stones, which are used in the printing press.

Of late "offset" printing is also used for various drawings and especially for sketch maps and preliminary publications.

The photographic department has two built-in camera's, in which the operator can move when focussing on frosted glass and when fixing the wet collodion plates, which generally measure 90 by 90 cm. or 80 by 110 cm. There are further a number of large bellow camera's which with the focussing screen are placed on rails in front of the drawing. The largest plates which can be used in these measure 80 by 100 cm.

The process block division produces annually about 3000 autotypes and line blocks.

There is further an installation for reproducing by roto gravure (depressed surface printing) with machine press.

In the lithographical department there are three lithographic machine presses and seven offset presses, further eighteen lithographic offset and zincographic handpresses, with the necessary auxiliary machinery.

The book printing department is arranged for letter press printing on maps and for block printing for illustrative work; it contains five machine presses and four platen presses.

The rate of increase of the work of reproduction is best seen from the following statement of the annual output of copies:

Year.	For the topographical service.	For other service branches.	Total.
1880	49.000	12.000	61.000
1890	76.000	15.000	91.000
1900	90.000	285.000	375.000
1910	665.000	550.000	1.215.000
1915	1.037.000	1.673.000	2.710.000
1920	2.102.000	5.909.000	7.572.000

APPENDIX II.

The hydrographic survey of the Dutch Indies

by J. Luymes.

During the first Dutch expeditions to the East Indian Archipelago, undertaken towards the end of the sixteenth century under the brothers Houtman, the maps of Petrus Plancius and of Jan Huygen van Linschoten were used. The former, a minister of religion as well as an acute cartographer succeeded in publishing in his world map of 1592 the most recent data on the East Indian Archipelago. A single copy of this map survives in the archepiscopal archives at Valencia; it was chiefly based on the work of the Portuguese geographer Bartolomeu Laso. Linschoten who as clerk to the archbishop of Goa had an excellent opportunity of learning what the Portuguese knew of the sea routes to the East, drew chiefly on the maps of Vaz Dourado. He further gave a mine of information in his celebrated "Reysgeschrift" which was also taken by Houtman's fleet. The United East-India Company which resulted from the voyages of Houtman, collected during its prolonged monopoly many new data on the hydrographic condition of the seas and coasts of the Archipelago.

By 1660 the outline of the coasts of these islands had been pretty well ascertained. It was pretty complete for Java, Sumatra and Borneo but still incomplete for Celebes, inaccurate for the smaller Sunda islands and the Molucca's, and sketchy as regards New Guinea.

The Company however kept its collected data secret as far as possible.

CHART SHOWING THE COASTS AND AREAS IN THE EASTERN ARCHIPELAGO, SURVEYED BY THE NETHERLAND'S NAVAL SURVEYING-SHIPS.
Surveyed coast and area
CHINA SEA
MALAKA
Malaka Strait
SUMATRA
Singapore
Natuna Is
Serawak
BORNEO
British North-Borneo
Mindanao
PHILIPPINES
PACIFIC OCEAN
Halmahera
Karimata Strait
Banka
Billiton
Makassar Strait
CELEBES
Ceram
NEW-GUINEA
Aroe Is
Batavia
Soenda Str.
INDIAN OCEAN
JAVA
Soerabaja
LITTLE SOENDA Is
Timor
Tanimbar Is
Soembo
AUSTRALIA

It gave to its captains valuable, beautifully ornamented charts, drawn on parchment, which on their return were brought up to date by adding the latest discoveries. But no large scale chart ever appeared for sale. It was only in the decline of the company's monopoly that the celebrated publisher VAN KEULEN could in 1753 make generally available the then state of knowledge of the geography of the Archipelago, in the sixth volume of the "Zee-Fakkel" (Sea torch).

With the methods and instruments of that period scarcely anything better could have been produced, but the introduction of the mirror sextant and of chronometers allowed of greater demands. In the beginning of the 19th century it was seen that the charts no longer satisfied modern ideas of accuracy and required to be prepared de novo. For this purpose a "Committee tot verbetering van zeekaarten" (Committee for the improvement of charts) was instituted which, however, only resulted in individual, albeit meritorious, attempts and by no means brought about a purposeful, comprehensive effort on a broad basis. Not until 1858 did the first Dutch survey ship begin its activities in the Archipelago! From that time onwards survey ships have been at work without intermission.

In 1883 their number was extended to three, in 1906 to four, and this number has been maintained. In the aggregate they have worked for 170 ship-years and as a result about four fifths of the very long coast line (estimated at 20.000 sea miles) has been charted in modern fashion. Assuming a uniform rate of progress, this work will be finished in 1934. The present position of the work is best shown by the annexed sketch map in which the systematically charted seas and coasts are coloured blue.

The charts of the uncoloured portions are compilations from all known data, collected in course of time by mariners and others. The whole Archipelago is charted on overlapping charts, both on the scale of 1 : 3.000.000 and on that of 1 : 1.000.000. On a scale of 1 : 500.000 the complete charting has only been accomplished for the coloured portions, showing lacunae in the remainder.

All coasts which have been surveyed systematically, are further represented on charts whose scale varies between 1 : 300.000 and 1 : 150.000 mostly 1 : 200.000. These coastal charts also join up with overlapping. Of the portions not systematically surveyed only a few coastal charts have been published.

There further exist a large number of charts on a scale of 1 : 125.000 and larger, of the most frequented portions of the Archipelago, of the less easily navigable waters and of various harbours, roadsteads, bays, anchorages, smaller islands etc. These latter charts are partly based on a systematic survey, partly on compilation. The extent of the charting

of the Archipelago is best seen from the following table, taken from the catalogue published in 1923.

Number of charts.	Scale.	Remarks.
2	1 : 3.000.000	Eastern and Western sheet
17	1 : 1.000.000	joining up to one whole
35	1 : 500.000	
108	1 : 300.000 to 1 : 150.000	with 810 detailed charts
192	1 : 125.000 and larger	und plans.
total number 354		

The regular publication of "Berichten aan Zeevarenden" (Notices to Mariners) gives an opportunity of keeping charts in use up to date. Further information of importance to shipping is collected in a "Zeemansgids voor den O. I. Archipel" (Mariner's Guide to the East Indian Archipelago") in six volumes with appended list of lights.

For the origin of the data given in this work on the domains of meteorology and tides we refer to the pamphlet on "Oceanography" in the present series. We may add that for eight important harbours with rather shallow access yearly tide tables are published, giving the minimum depth which may be expected from hour to hour in the fairway.

In the course of years various expeditions have visited the Archipelago. A complete list and description of these has been given in a publication of the Royal Dutch Geographical Society, entitled „De Zeeën van Nederlandsch Indië", which appeared in 1923.

The principal foreign ones were the English "Challenger" expedition (1874) and the German "Gazelle" (1875) and "Valdivia" (1898—99) expeditions. Owing to the extent of the Archipelago the visit of these vessels was more or less cursory. So that the Dutch "Siboga" expedition 1899—1900) which limited its activities to the Archipelago, could obtain more important results. These in conjunction with the results of earlier expeditions, of survey vessels, of numerous ships of war and of cable ships allowed of the compilation of a complete bathymetric sketch map of the Archipelago. The latest edition of this map is published in the above mentioned work of the geographical society, together with a description of its sources and the methods employed.

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